THE INSTITUTE OF PHYSICS
47 BELGRAVE SQUARE, LONDON, S.W.1.

BULLETIN

No. 49 JANUARY, 1954

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The Bulletin is not intended for general circulation : your copy should not therefore be passed to a library.

APPOINTMENTS VACANT

The inclusion of particulars of a vacancy must not be taken to imply that the Institute necessarily approves of the terms offered or that might be offered. Candidates should satisfy themselves that these are satisfactory, and they may always refer to the Institute for advice.

LEEDS COLLEGE OF TECHNOLOGY
Principal : C. Chew, M.Sc.Tech., F.R.I.C.
Required for May 1954, or earlier, full-time teacher of physics with good physics degree and preferably with teaching, industrial or research experience, particularly in high vacuum work.
Salary: Burnham Scale B, £480 x £25 – £765, but probably £525 x £25 – £820 from April, 1954. Additions for training, qualifications, experience and war service.
For particulars apply, with stamped addressed envelope to the Chief Education Officer, Education Offices, Leeds, 1. Closing date January 30, 1954.

City of Cardiff Education Committee. College of Technology and Commerce.
Principal : Dr. A. Harvey. Applications are invited for a full-time **Lecturer** in Physics. Candidates must have a good Honours degree in Physics or an equivalent qualification and have had suitable teaching, industrial or research experience.
A good knowledge of both Physical and Geometric Optics is essential. Experience in some branch of Applied Optics or of Ophthalmic Optics is desirable.
The salary will be in accordance with the 1951 Burnham Report, i.e., £940 x £25 – £1,040 (for men) ; £752 x £20 – £832 (for women).
Forms of application, together with further particulars, may be obtained from the undersigned on receipt of a stamped addressed envelope and should be returned as soon as possible.—Robert E. Presswood, Director of Education, City Hall, Cardiff.

Ferranti Ltd. (Moston), Manchester, invite applications for the following vacancies on the staff of their expanding Cathode-Ray Tube Department.
(1) **Engineers** and **Physicists** possessing a good Honours degree and preferably with experience of research and development work in electronic devices. The work covers the following fields :—Thermionic emission, vacuum techniques, electron optics, photo-electric phenomena, electronic circuits, glass technology and high voltage techniques. Reference CRT.1.
(2) **Engineers** of approximately graduate status for Process Control in the production of cathode-ray tubes. Reference CRT.2.
The salary scale for the above appointments would be in the range of £450 to £1,500 depending on age, qualifications and experience. The Company has a Staff Pension Scheme. Application forms from **Mr. R. J. Hebbert, Staff Manager, Ferranti Ltd., Hollinwood, Lancs.** Please quote appropriate reference.

Manchester Municipal College of Technology. The Governing Body invites applications from **Science Graduates** for a full-time teaching and research appointment in the Department of Printing and Photographic Technology.
Candidates should have a degree in Physics or Chemistry. A knowledge of the printing, photographic or related industries an advantage but not essential. Duties mainly research which will provide opportunity of working for a higher degree.
Salary scale £490 per annum rising by annual increments of £25 to £765. Subject to this maximum not being exceeded, one increment of £18 will be added to the minimum in respect of each year of approved industrial experience up to a maximum of twelve, together with one further increment (usually of £18) for each year of previous full-time teaching service. There are also certain additional training and graduate allowances.
Form of application may be obtained from the Registrar, College of Technology, Manchester 1. Last day for the receipt of applications is January 22, 1954.
Canvassing, either directly or indirectly, will disqualify a candidate for appointment. B. V. Bowden, Principal.

Physicists and **Electrical Engineers** required by Ministry of Supply, R.A.E., Farnborough, Hants., for :—(1) Development of variety of precision electrical equipments for application to research problems in aircraft flight control ; (2) Research on problems of aircraft flutter and vibration ; (3) Research and development of gyroscopic and allied instruments ; (4) Research in techniques and instrumentation for measurement and recording of physical quantities for aircraft tests ; (5) Research on new light electro-magnetic devices for data transmission, and investigation of the dynamics of servo systems. Qualifications : 1st or 2nd class honours degree or equivalent in physics or light electrical engineering. Knowledge of electronics an advantage for some posts. Salaries within range, Scientific Officer, £417 – £781. Women somewhat less. Posts unestablished. F.S.S.U. benefits may be available. Application forms from **M.L.N.S., Technical and Scientific Register (K), 26 King Street, London, S.W.1,** quoting A.324/53A. Closing date January 29, 1954.

Physicist for textile laboratory of rayon production plant in the North West. Applicants should have good honours degree. Experience in the textile industry would be an advantage but is not essential. Salary commensurate with age and qualifications. Pension scheme. Box P.914, Lee & Nightingale, North House, North John Street, Liverpool, 2.

Honours physicist required for research on the friction and lubrication of textile materials. Previous experience in this field an advantage. Apply in writing to the **Director, Shirley Institute, Manchester 20.**

Leading London X-ray Company has vacancies for the following staff :
Engineer or Physicist, graduate, with experience of light engineering and preferable medical radiography, as assistant to Chief Engineer. Candidate otherwise acceptable will be given training in radiography. Ref. : T.A.
Technical Writer, with knowledge of engineering and electrical circuits to prepare instruction manuals for X-Ray equipment. Knowledge of medical radiography an advantage. Ref. : W.
Write giving age, details of experience and salary required to Box No. A.V. 52 quoting above reference.

(*Continued on page iii*)

THE INSTITUTE OF PHYSICS

No. 49 **BULLETIN** JANUARY, 1954

NOTICES TO MEMBERS

Bulletin Format

With this issue the *Bulletin* appears in an entirely new style which affords substantial advantages for its preparation and which it is hoped will be considered by members to be an improvement.

It was largely because of war-time needs that the Institute first began in 1941 the occasional publication of *Notes and Notices* which kept members informed of important professional matters. In January 1950 this was replaced by the regular monthly *Bulletin* which has been developed gradually to include articles of interest to members, such as the series on Research Associations and on Technical Colleges (the last of this series being in this issue), book reviews and correspondence. Primarily, however, the *Bulletin* aims to keep members up to date in matters of professional interest and to give notice of Institute activities.

In future, announcements of vacancies and other advertisements will be printed only on the cover or specially inserted pages with separate pagination. Some members like to keep their copies of the *Bulletin* and the new arrangement will enable them to bind the annual volume free of advertising matter. A title page and index will be issued annually.

The late Mr. R. S. Whipple

Members will regret to learn that Mr. Robert Stewart Whipple died on December 13 at the age of 82. Mr. Whipple was one of the founders of the Institute and had served on the Board for a total of no less than 21 years ; he continued as a member of the Finance Committee until the time of his death. For most of his life Mr. Whipple was connected with the Cambridge Instrument Company Ltd., for 26 years as Joint Managing Director and for 10 years as Chairman of the Directors. He had gathered together a unique collection of historical scientific instruments and books which he gave to the University of Cambridge in 1944 for display in the museum devoted to the history of science.

Mr. Whipple took a great interest in everything connected with the Institute and was one of its most generous benefactors. His son, Mr. G. A. Whipple, is also a Fellow of the Institute.

The Institute was represented at the Memorial Service which preceded the private funeral.

RESEARCH ASSOCIATIONS
IV — THE WOOL INDUSTRIES RESEARCH ASSOCIATION, LEEDS

By A. B. D. CASSIE, M.A., D.Sc., F.Inst.P.

The honours physics graduate fresh from his courses on atomic physics might well wonder how wool has become a topic for the Institute's *Bulletin* ; for the easy comfort of his suit contrasts strikingly with the physical theory that he has learned, and which fits so accurately the empirical results recorded in text books. Perhaps if he has done some research, he will realize that theory does not always fit the facts so well, and he may, too, begin to think that his suit is not so good ; both could be improved and inquiry or research is needed to bring it about.

There have, of course, been changes in wool processing throughout the ages, but by 1915 members of the West Riding wool textile industry had come to realize that something more than spasmodic and isolated attempts at improvement were needed ; they accordingly formed and financed a West Riding Textile Research Committee. The purpose of the Committee was to sponsor research at Universities and Technical Colleges which would give them a fuller understanding of the principles of wool processing and of the chemistry and physics of the fibres they used. The Committee was, in fact, an embryo Research Association and in 1918, when the Department of Scientific and Industrial Research formulated its scheme for Research Associations, the Committee was able to take advantage of it to form the Wool Industries Research Association. The Association was maintained by voluntary subscriptions and Department of Scientific and Industrial Research grants until the 1st of November, 1950, when, at the request of the industry, an Order was passed through Parliament instituting a statutory levy for research purposes. The Association is now financed by money received from this levy together with the Department of Scientific and Industrial Research grant. In addition, since 1938, the Wool Boards of Australia, New Zealand and South Africa have contributed generously to the Association. The income at present is around £160,000 per annum. The governing body of the Association is its Council, elected by the members. It has power to co-opt scientific and other persons able to help with its deliberations.

The wool industry is in reality four industries ; there are the woollen and the worsted industries which represent different methods of converting fibre masses into yarns ; then there is the shoddy industry which converts used fabrics and other wastes into fibres suitable for further processing and use ; and there is the pressed felt industry which makes a very wide range of fabrics and felts for use as engineering

materials. Indeed, some pressed felts are almost like wood in their hardness and general properties, whilst at the other extreme there are paper makers' felts and printers' blankets, which have to be made very accurately in thickness so that the newsprint coming from the machines is of a uniform character. The Association is too small to cover research in all these fields and it attempts rather to investigate processes that are common to most of them.

There is within the organization a pure physics department : applied physics is used in a number of sections dealing with the processes of carding, drawing and spinning on the worsted system ; carding and spinning on the woollen system ; and weaving. There are, in addition, physical testing and electronics laboratories with their own staffs.

The physics department covers a wide range of activities, as many of the more fundamental physical problems arise from the chemical processes of dyeing and finishing : the physical problems are heat, liquid, and water vapour transport, including the diffusion of materials into fibre networks, and finally into the fibres themselves. Thus, it is no easy matter to replace one solution enmeshed in a piece of fabric by a second solution, and much of the time required in chemical processing is due to this difficulty. The fibres themselves have enormous surface areas ; for example, one pound of merino wool has a total fibre surface of 800 sq. ft., which means that the solid material of the fibres is very well exposed to the medium surrounding it. Absorption processes by

Fig. 1 — The physics block

fibres can, therefore, be quite rapid and an early success of the physics department was to show how rapid this could be for the absorption of water vapour. The thermo-dynamic consequences of this discovery proved of great significance with regard to clothing comfort and also with regard to the drying and uptake of water vapour by textile materials during processing. The work focused attention on the need for adequate air-flow to provide not only water vapour exchanges, but also for the provision of adequate heat or the removal of heat during these processes. Indeed, it was possible to predict from thermo-dynamic arguments alone, how much steam should be used in these processes and it is satisfactory to know that modern drying and conditioning machines are approaching the predicted efficiencies. The diffusion of larger molecules into fibres is not so rapid and a study is in progress at present which aims at elucidating the mechanism of absorption of dye molecules by the fibres. The problem here is essentially one of ionic transport and radio-active tracers have been used with considerable success in clearing up the complex reactions that arise when fibres are immersed in a dyebath which usually contains, in addition to the dye, ions derived from salts and acids. Work of this type often provides interesting evidence on fundamental theory : in this case the results have been used to separate boundary membrane potentials from diffusion potentials in systems of this kind. The work of preparing radio-active dyestuffs in a pure state is also an interesting study.

Another problem that is being actively pursued in the physics department is that of the dissipation of static electricity. It has long been known that non-conducting fibres are much more liable to produce static than conducting ones. A recent theoretical investigation of the dissipation of static has provided a picture of the distribution of static charge on fibres being withdrawn from a pair of rollers, together with the electric field distribution. This analysis revealed that the electric field is wholly normal to the fibre except at points very close to the nip of the rollers where there is a small tangential component of the field. Such a field distribution immediately suggested that conductivity of the fibres themselves would not be so powerful in dissipating static as would a trace of conducting material at the nip of the rollers. Experiment soon showed that this conclusion was true and that porous metal rollers impregnated with conducting liquid would completely eliminate static electrification, even though the fibres had little conductivity and carried away practically none of the conducting liquid. This is the principle on which modern anti-static agents work, although they are normally applied to the fibres rather than to the rollers. However, it would be more economical to apply them to the rollers and steps are at present being taken to see how far this can be carried into commercial practice.

The large fibre surface of textiles immediately suggests that friction is an important feature of these materials, and work has, in fact, been done on friction for many years. Only recently, however, has a determined theoretical attack been made on the problem. Following up the work of Bowden and his colleagues on the friction of metals, work was done in the laboratories on the friction between plastic surfaces. It soon became apparent that in contrast to metals, the frictional properties were determined by the elastic deformation of the plastic rather than by its plastic deformation ; and, as was the case with metals, this discovery provided a relation between the coefficient of friction of plastic materials, their elastic coefficients and shear strength.

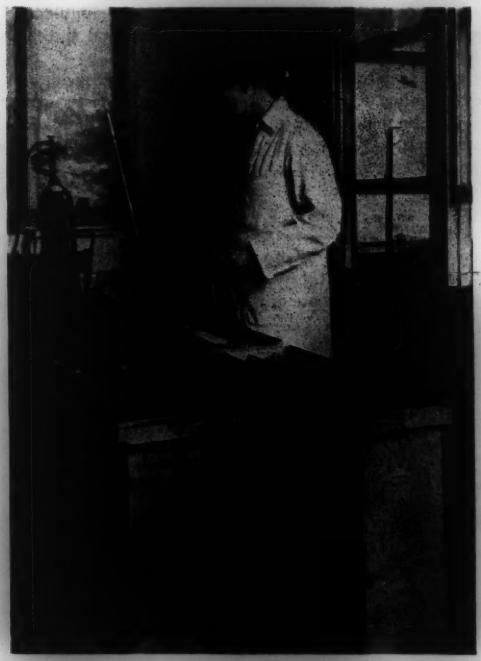

Fig. 2 — Analysis by partition chromatography

An evaluation of the true area of contact by optical methods has served to confirm many of the geometrical calculations.

In addition to equipment required for investigating these general physics problems, X-ray and infra-red apparatus is in use in the laboratories. X-ray investigations cover the structure of peptides and are linked closely with work being done in the Chemistry Department on the analysis of wool. The principal method now used for the analysis of wool hydrolysates is a physical one—partition chromatography. It was invented in the laboratories of the Association by Dr. A. J. P. Martin—a physicist—and Dr. R. L. M. Synge—a biochemist. The method is now well known and is very widely applied to chemical analyses of all sorts ; so much so, in fact, that Martin and Synge were awarded the Nobel Prize in Chemistry for 1952 for this discovery. No better tribute could be paid to the opportunities available at Research Associations for doing work of the most fundamental and far-reaching character.

The great majority of textile processes are mechanical, and as such provide unlimited opportunities for applied physics research. If progress is to be maintained, physics allied with mathematics must be used continuously. Thus, there is the carding engine which converts a tangled and unseemly mass of fibres into a fine web : the web is cut along its length and the resulting ribbons are rubbed and twisted to form woollen yarn ; or the web is taken off the card as one thick rope and subsequently drafted in as many as ten to twelve operations to form a worsted yarn. The carding machine which performs the rather surprising transformation of raw wool to a web, consists of rotating cylinders some of which are as much as 4ft. 6ins. in diameter and

Fig. 3 — The wool card

60ins. wide, and from the outer surfaces of these cylinders project innumerable wire teeth. The teeth are designed to remove fibres from one cylinder and replace them on another, the process being repeated very many times before the final web is produced. The action of the card is a physical one and a study of the transfer of fibres from one cylinder to another and the mixing power of these cylinders, provides a most interesting physical study which must be coupled with adequate mathematical analysis. Control instruments for the card are now being developed, one of them a photo-electric device which measures the thickness of the web and controls the speed of the last part of the card so that this thickness is maintained at a constant value. Such a controller may seem a simple device to the non-textile physicist but the reactions of this complex machine to control are not at all straightforward, and much mathematical analysis has been necessary to find the correct type of controller. An electrical analogue of the card was built for this purpose, and it has proved possible by feeding electrical impulses, instead of wool, into this analogue machine to obtain considerable insight into the working of the card and its reaction to changes of speed of different cylinders. One important aim in this and other processes is to preserve fibre length, and the correct measurement of fibre length depends greatly on correct sampling which again is an interesting mathematical problem.

Turning for a moment to worsted processing, there are the problems of what happens when a thick rope or sliver of fibres is continuously extended to reduce its thickness. What, for example, is the correct mechanism to control this thinning process, bearing in mind that the sliver contains fibres of many different lengths which cannot always be under the control of the slowly moving back rollers or the fast moving front ones ? Here again, radio-active tracers have proved their worth. It has been found possible to impregnate a few of the fibres with radio-active phosphorus and to replace them in the sliver with the other fibres. Two Geiger counters, placed at different points in the drafting zone, where thinning of the sliver takes place, then enable the passage of these occasional fibres through the zone to be followed ; how and when they are accelerated from the low to the high speed are readily deduced from the Geiger counter records. This experiment has revealed features of the process that had previously been unsuspected ; thus, the fibres seem to move almost by chance and may be accelerated from a low to a high speed and subsequently decelerated once again to the low speed. Rapid acceleration of the fibres had always been suspected because of their low inertia, but the acceleration and deceleration is a feature of the process that had not been previously revealed, and which any adequate theory of drafting should explain.

Measurement of the regularity of slivers and yarns is, of course, of

fundamental importance to all work of this type and instruments have been devised by physicists which do this satisfactorily. There are, however, many problems still to be solved on how best to express the results and at present there is considerable activity on the design and use of appropriate computing machines. These are of both the digital and continuous electronic circuit type. The measuring instruments are also now being incorporated in the machines themselves so as to control the draft to maintain the output at a constant weight per unit length.

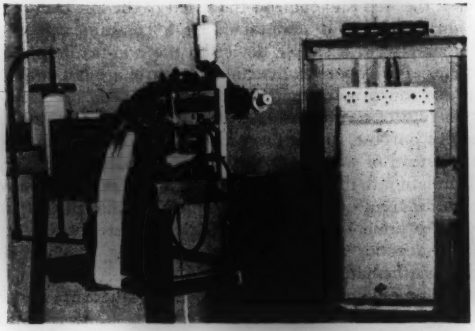

Fig. 4 — The Wool Industries Research Association roving levelness tester and computor

In spinning, one of the interesting physical problems is the control of tension in the yarn finally delivered to the spinning bobbins. Wool fibres when stretched and held stretched for any time, as happens in the case of yarn wound on to a solid bobbin, tend to become set at their stretched length, but the fibres lose their set and recover their original length as soon as they are immersed in water, which occurs in the finishing of cloth. If the yarns are spun or wound at different tensions, the length recovered on finishing a fabric will be variable and will lead to cockle and the unsightly appearance of finished fabrics. The control of tension from spinning onwards is, therefore, of vital importance ; but it is rather difficult to design a spinning mechanism which will wind yarn on to an empty bobbin at the same tension as it is wound on to a full one. Some progress is, however, being made in this respect, though even the measurement of tension during spinning is quite a tricky physical problem. The control of tension should follow right through to weaving and much research into the weaving process concerns the

best way of maintaining a constant tension in every thread. This is no easy matter when it is remembered that one warp may have as many as 6,000 separate ends or yarns and across this may be put as many as 50 to 100 yarns for every inch of length of the cloth. The weft yarns—those that cross the warp—come from shuttles and another problem is how to maintain at a constant value the tension of a yarn coming from a shuttle. This is, in part, the spinning problem in reverse because the yarn comes off the full package in the shuttle at a lower tension than it does when the package is almost empty. It is possible to see in a fabric where packages in a shuttle were changed because of the effect of the change in tension. This effect is, to some extent, minimized in weaving wool yarns by the use of several shuttles so that there is always a mixture of yarns at high and at low tension. This is, however, an unsatisfactory compromise, and further investigation of the unwinding of yarn from packages is much to be desired. The timing and setting of a loom, the correct design of temples which hold the cloth at full width in the loom and which may be strained to such an extent as to tear the cloth, are all problems that require continuous review by physical and mathematical methods.

These are, in broad outline, a few of the more usual textile processes and the problems that they raise. What facilities are available for their investigation ? The applied physics laboratories are housed in the main physics block, the whole of which is air-conditioned to maintain a relative humidity of 50%, except in summer when refrigeration would be required. One section of this block is controlled at 65°F. and 70% R.H. throughout the year by means of conditioning plant which incorporates refrigeration. Control of these conditions is essential for accurate measurements on fibres whose physical properties vary greatly with their moisture content. Full-scale processing machines are available for the applied physics sections and are housed in separate buildings, most of them with humidity control. Many measurements are made on these machines using methods that have become common in the aircraft industry, such as strain gauges, usually coupled to cathode-ray oscilloscopes, because many of the movements which have to be followed, take place very rapidly. There is also a drawing office and machine-shop which makes all mechanisms ranging from instruments to parts for textile machines. In addition, the physics department has a small mechanical workshop which also produces special glass-ware required in the laboratories.

The physical testing laboratory is equipped with all manner of machines, including an " Instron " tester which recc ls load elongation curves ranging from breaking loads of 2 grams to 500 kilograms. The curves may be obtained at either constant rate of loading or constant rate of elongation. Statistical methods are used in most applied

physics work and a good knowledge of statistics is soon acquired by physicists working in these fields. Computing machines are available and routine calculations are done by assistants.

Finally there is a technical survey section which makes observations and measurements in mills and the results of its work often determine the priority of research projects. Experience has shown that in technical survey work it is the physicist who produces the most effective results. There is, thus, a very wide field for the physicist to choose from in the Wool Industries Research Association. He may work on the fundamental side where his activities are similar to those of a university research worker, or he may choose a career with more practical interests ranging from the use of radio-active isotopes to the planning of experiments to be done under mill conditions.

INSTITUTE CONFERENCES

The second half-sessional list of Branch and Group meetings will be circulated to members during January. The attention of members is specially drawn to the following conferences to be held during the first half of 1954 ; details and forms of application to attend those conferences marked * may now be obtained from the Deputy Secretary of the Institute.

Date	*Place*	*Subject*	*Organizers*
Mar. 23–26	Nottingham	Stress Analysis (all branches)	Stress Analysis Group
*April 1–2	Cambridge	Modern Structure Analysis	X-ray Analysis Group
*April 6–9	Nottingham	Physics of particle size analysis	Institute
*April 7–10	Cambridge	Luminescence	Electronics Group
April 12–13	London	(to be announced)	Education Group.
July 7–10	Birmingham	Non-destructive testing	Industrial Radiology Group and Midlands Branch
*July 16–21	London	Electron Microscopy	Electron Microscopy Group as hosts for International Conference

PHYSICS IN TECHNICAL COLLEGES
VII—SIR JOHN CASS COLLEGE, LONDON

By R. H. HUMPHRY, M.Sc., F.Inst.P.

INTRODUCTION

Sir John Cass College is administered by the Governors of Sir John Cass's Foundation, an educational foundation established in 1710 by Sir John Cass, an Alderman of the City of London. Its work is aided by the London County Council and it is affiliated with the University of London as an institution having Recognized Teachers. The links with the City of London and the University have an important bearing on the outlook and character of the work done in the College. In the Faculties of Science and Engineering (Metallurgy), it is the only place of its kind in the City and past students, many of them now in responsible positions in research and industrial laboratories, are often heard to refer with some affection to their association with the "Cass."

Two historical pieces exist within the College, the first being a lead statue of the founder, executed by the contemporary sculptor Roubillac and considered to be one of the finest examples of lead casting in the country and the second a portion of the Roman wall of London, which, as it happens, is to be found in the Physics Department.

The Department has developed in the 51 years of its existence under four Heads—Dr. R. S. Willows, Mr. F. J. Harlow, Dr. D. Owen and the writer of the present article. Emphasis has always been placed on the more advanced work and, at the present time, the Department is concerned almost exclusively with University work of degree and higher degree level. A few short courses of special lectures on subjects which lie more in the field of applied physics are held, however, and attract physicists and others from industrial research departments.

STAFF

The full-time teaching staff of the Department numbers eight and there are four visiting lecturers. It has been a general policy to restrict the number of part-time lecturers to a minimum and to increase the number of full-time members of the staff, as far as possible, thus allowing much greater opportunity for students to receive tutorial and other guidance. Moreover, the members of the Department are able to assume a more direct responsibility in its development and have time to undertake research, which, as far as other duties permit, they are expected to do. Discussion on research and other problems is stimulated by the fact that some members of the staff have interests mainly in theoretical physics, while the interests of other members lie more on the experimental side.

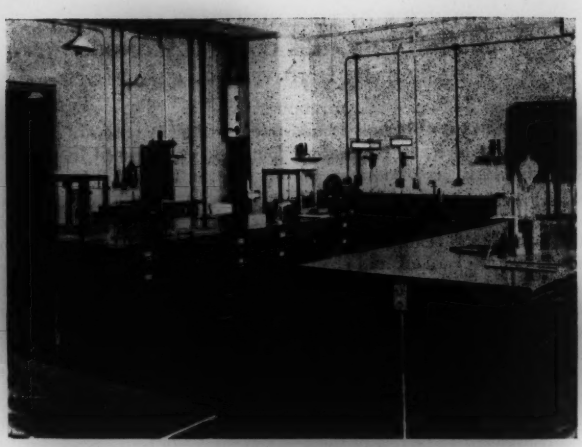

Fig. 1 — The general laboratory

ACCOMMODATION AND EQUIPMENT

The Department consists at present of two lecture rooms, five laboratories, of which three are used for normal teaching, two optical darkrooms, one photographic darkroom, a small workshop and a store. In one laboratory are set up a Finch electron diffraction camera and a Raymax X-ray crystallographic unit. Another small laboratory is used mainly for research not involving electron diffraction or X-ray methods. The lecture rooms, although primarily available for physics classes, are used for other subjects ; this makes the preparation of lecture demonstrations difficult at times.

The workshop is inadequate in size for the amount of research and constructional work which is being attempted. However, the promise of further accommodation when a present building scheme is completed may make it possible to remedy this deficiency. It will also make possible an extension of the research section.

The equipment of the Department is both good and extensive. This is particularly so on the electrical and optical sides. There are few standard or fundamental physical experiments which could not be carried out in the laboratories. Students taking the full course gain a practical acquaintance with all the normal types of instrument and apparatus which they are likely to meet in the physical laboratories of firms and other establishments. The equipment is augmented year

by year and a stage is now being reached where the storage of apparatus, when not in use, is presenting a new problem. Smaller pieces of apparatus and some of that needed for lecture demonstrations are constructed in the workshop, which is equipped for most normal mechanical operations, except milling, and for glassblowing.

UNDERGRADUATE COURSES

Full-time and part-time courses are arranged for Intermediate, B.Sc. (General) and B.Sc. (Special), Part I and Part II, under the revised regulations. There are also courses in Physics Ancillary to Special Chemistry and in Applied Electricity for students taking a degree in Metallurgy. All these are Internal courses. In addition to lectures and practical work there are tutorial classes in most of the above where exercises are worked out and difficulties resolved. A class in scientific German for the translation test in physics is also held.

Students working for the Graduateship examination of the Institute take selected parts of the degree courses, usually the whole of the B.Sc. (General) course with the addition of selected parts of the Special, Part I, course.

Fig. 2 — The advanced laboratory. The workshop is at the far end with an optical dark-room on the right

At the B.Sc. (Special), the examination for Part I is a common examination for all Internal students, but in Part II selected subjects are studied in a more advanced and extensive manner. The subjects treated at the College have been Advanced Electricity, Quantum Mechanics and Physics of the Solid State. The practical work in Part II is also of a completely different character. Students are given problems of a semi-research nature and are encouraged, under guidance, to design, construct, test and use the necessary apparatus. At the end of the investigation, which may take the best part of a term, a report is presented including abstracts of any papers, etc., which may have been consulted in the course of the work. This constitutes a very valuable training and is only possible under the flexible conditions of the Part II course. Students in their last year are also expected to make one or two precision measurements using the high-grade equipment to which reference has already been made.

POSTGRADUATE AND RESEARCH WORK

A small, though important section of the work of the Department are the special courses of lectures. One or two such courses of from four to ten lectures are generally given in each term by acknowledged experts. Although intended mainly for graduates and workers in research laboratories, the courses are arranged so that degree students in their final year can gain some knowledge of special subjects which cannot be so fully treated in normal lectures. The subjects of these courses are, at present, Ferro-electricity, Electron Diffraction and its applications, Radiation Detectors and Counters, X-ray and Optical Crystallography and a short practical course in the last-named.

The research which is carried on in the Department is on a variety of topics. The Raymax X-ray unit has been used for investigations into the deformation of single crystals of metals and for the practical course mentioned above. It is equipped with a single crystal goniometer, a powder camera, a back reflection camera and a high temperature powder camera. Related optical investigations can be made by means of an optical goniometer and a high grade microscope with polarizing attachments.

The electron diffraction apparatus is more recent and will be applied more in the investigation of surface structures, by reflection, than in the investigation of thin films by transmission, although both methods of investigation are available.

Apart from the laboratory housing these two units, the space available for experimental research is not large at present, although a considerable expansion is envisaged when new laboratories are added to the Department. Investigations are in progress, on the experimental side, into (*a*) the physical properties of metallic crystals, (*b*) diffraction

Fig. 3 — Electron diffraction equipment with the "Raymax"

of slow electrons and their detection by photographic means, (*c*) colour vision with special reference to hue discrimination under various conditions, (*d*) the freezing of water drops with reference to problems connected with thunder clouds and (*e*) other electrical phenomena related to the lightning discharge. Some theoretical investigations are being made in the kinetic theory of liquids and allied subjects. There are at present one full-time and four part-time research students. Their supervision is not an easy task for the staff who have other teaching duties, but it is very willingly undertaken. During the last year two M.Sc. degrees were gained.

STUDENT ACTIVITIES

There is a flourishing students' union in the College and students of the Department take their share in these activities. The College Physical Society is of long standing, being the oldest of the various

societies, and performs a semi-scientific and semi-social function. Lectures, discussions, film evenings and debates are held from time to time and visits are made to works and research laboratories. Each year a noted physicist is invited to give a Distinguished Visitor's Address and a visit is made at the end of the second term to some place of interest outside London. Recent visits of this kind have included the Physics Departments of the Universities of Birmingham and Bristol and the Rothamsted Experimental Station.

It will thus be seen that, in addition to training for examinations, we seek to give students a lively interest in physics in its wider implications in the hope that they will be better equipped to undertake the responsibilities of the posts to which they go.

REVIEWS OF BOOKS

Electricity and Magnetism for Degree Students. By S. G. STARLING. (London : Longmans Green & Co. Ltd.) Pp. viii + 650. Price 32s.

It is a privilege, fraught with some responsibility, to review the new edition of a famous book (the first edition appeared in 1912), especially when the task brings back memories of one's student days. Undergraduates often comment destructively on things in general, and books and lecturers in particular, and I was no exception. However, I remember, and I shall use the first person deliberately since this is a personal matter, reading my copy of Starling (5th Edition, 1932, on the fly leaf), fairly assiduously in my first year physics course, and the distribution of grime on the outer edges of the pages, particularly for pp. 50–380, proves this. The latter shows also what I still believe to be the best parts of the book, namely, the chapters on elementary electromagnetism and electrostatics.

This new edition (the 8th, following many new impressions of earlier editions) will, I hope, still be read by first year students in physics and electrical engineering, since I do not believe that there are many (if any) better books. But it must be stated frankly that the new material does not seem to be written into the older parts of the book, but to be appended to it. Examples of this are the short section on new geomagnetic work (a matter of great physical interest), on molecular theories of magnetism (pp. 293–296) and on certain new material in nuclear physics (pp. 618–625). The cathode ray oscillograph is hardly mentioned, although it can be used to demonstrate many of the effects and results given. Should not the use of vectors be stressed more ? Would it not be better to omit much of the later part of the book on atomic and nuclear physics and to expand the

treatment of magnetism and other matters ? Should not wave propagation in bounded media be introduced ? Is the valiant but brief rear-guard action fought by the authors against M.K.S. units on p. 405 really justified ? Like many other physicists, I do not feel very strongly about this, but opinions differ considerably.

Many of these points are matters of personal opinion, and it is important to make clear that the mere survival of this book, after 40 years, quite apart from its present extensive use in several Universities, shows its general excellence.

The price of the book is very reasonable, and the technical production is of a high quality. J. D. CRAGGS.

Practical Metrology, Volume I. By K. J. HUME, B.Sc., M.I.Mech.E., M.I.Prod.E., and G. H. SHARP. (London : Macdonald & Co. (Publishers) Ltd.). Pp. 60. Price 6s.

This enterprising instructional manual, the first of a projected series of four describing laboratory experiments in engineering dimensional metrology, is devoted to 12 experiments in measuring simple limit gauges and verifying small measuring tools. Judged from this first instalment the whole should meet a need long felt by those concerned with the practical training of engineering students in courses for National Certificates and the like. I suggest that some of the experiments could well be included in courses on applied physics, just as the authors plead the need for a better knowledge of physics among engineers.

Notes are included on the care of equipment, recording of observations, calculations and assessment of accuracy. More stress could well be given to the proper assessment of accuracy ; an analogous criticism applies to the treatment of error in different experiments. Care should be exercised in choosing scales for the graphical representation of results ; in Fig. 2 the vertical scale is too large in relation to the accuracy of measurement. It is unwise to imply that a micrometer is suitable for measuring plug gauges with a manufacturing tolerance of 0.0002 in. Ovality in cylindrical work might not be discovered if diamentral measurements are only made " at two positions at approximately 90° apart." A very good educative point is the reference to relevant British Standard Specifications for assessing performance or accuracy.

The manual is well printed and bound in a durable cover giving credit, alas, to one author only (and the publisher) on the back ! Basic principles are mostly expounded in a manner befitting the experience of two " old boys " of the Metrology Division, National Physical Laboratory. I strongly recommend this volume to all those with interests in imparting a practical knowledge of the science (and art) or measurement. H. BARRELL.

THE REGISTER

ELECTIONS TO MEMBERSHIP

An asterisk (*) indicates transfer from another grade

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Warden, Malcolm Phillips, B.Sc., University College, Cardiff.

Watkins, Trevor Lewis, B.Sc., Demonstrator, Department of Physics, University College of North Staffordshire.

Wignall, John William Craydon, B.A., B.Sc., Research Student, University of Melbourne, Australia.

Wool Industries Research Association. Operational Research. Male graduate with Honours or General degree in Physics required for production studies in wool textile mills. Knowledge of statistical methods an advantage. The initial salary will be in the range £400 – £600 p.a. with F.S.S.U. superannuation after probationary period. Applications should be sent to the Association, Torridon, Headingley, Leeds, 6.

Air Ministry requires **Scientific Officer** (male) at R.A.F. station near Oxford for operational research duties in connection with aerial photography. Qualifications : First or second class honours degree, or equivalent, in mathematics or physics. Salary : Within range £417 – £781. Post unestablished with possibilities of establishment through the Civil Service Commission for successful candidate whilst remaining under age 31. Opportunities for promotion to higher grade posts on staff of Scientific Adviser to Air Ministry. Application forms, quoting A.313/53A from M.L.N.S., Technical and Scientific Register (K), King Street, London, S.W.1. Closing date January 23, 1954.

Wool Industries Research Association. Physicists with 1st or 2nd class honours degree and some research experience required as follows :
(1) For fundamental research on the diffusion of ions in the protein keratin, and related substances, using radio tracer methods.
(2) For fundamental research on friction and abrasion between high polymers and metals.
(3) For investigation of the mechanics of fibre movement using electronic and radioactive techniques.
Previous research experience in these subjects not essential. Commencing salary according to age and experience in the range £600 – £800 p.a. with F.S.S.U. benefits. Applications should be sent to the Association, Torridon, Headingley, Leeds, 6.

British Electricity Authority, London Division. Applications are invited for the following superannuable post. Salary including London Allowance, and conditions of service in accordance with N.J.B. Agreement, Schedule C. Qualifications entitling to Graduate Membership of the I.E.E. an advantage. General Assistant Engineer—communications at divisional headquarters. Duties will include maintenance of Private Communications System using Line, Teleprinter and Radio techniques. Previous experience of this work or with a telephone manufacturer desirable. Preference given to holders of H.N.C. in Engineering or Scientific equivalent.
Salary (subject to superannuation deductions) within the range £526 1s. 0d. to £670 19s. 0d. rising to ultimate maximum £749 14s. 0d. Opportunities occur for promotion. Application may be made on form obtainable from Divisional Secretary, B.E.A., London Division, Generation House, Great Portland Street, W.1, and be received within 14 days of this advertisement.

City of Portsmouth College of Technology. Principal : William Taylor, D.Sc., F.R.I.C. Laboratory Steward required in the Physics Department of the College of Technology. It would be an advantage if applicants have passed an appropriate City and Guilds or National Certificate Examination. Salary Scale £375 x £15 – £420 x £20 – £440. Applications in writing should be forwarded to the Registrar as soon as possible. E. G. Barnard, Chief Education Officer.

University College of North Staffordshire. Assistant Lecturer in Physics. Applications invited from honours graduates with post-graduate experience. Salary range £475 x £25 – £525 with F.S.S.U. and children's allowances, initial salary depending on experience and qualifications. Appointment from April 21, 1954, or as soon thereafter as can be arranged. Facilities for research in solid state physics, gas discharges, etc. Members of academic staff are normally required to live in a house or other accommodation within the College grounds, when available. Applications in duplicate on the prescribed form should reach the Registrar, University College, Keele, Staffs., from whom further particulars may be obtained, not later than January 31, 1954.

Three **Research Scientists** (men) required in September, 1954, for work on (a) the structure of high melting alloys and (b) structural changes produced by martensitic transformations and mechanical deformation of metals. At least one must be a physicist. The work is arranged so that the man appointed qualifies as an advanced student for the Oxford D.Phil. degree. First or good second class honours degree in physics, chemistry or metallurgy required. Salary according to age and experience. Apply in writing to **Dr. W. Hume-Rothery, O.B.E., F.R.S., Inorganic Chemistry Laboratory, South Parks Road, Oxford.**

Imperial Chemical Industries Ltd., Dyestuffs Division, has a vacancy for a physicist in the Instrument Development Section of the Engineering Department. Candidates should have a thorough knowledge of classical physics and be interested in applying this to practical problems associated with the development of plant instruments, particularly for product analysis. After some years there will be opportunities for advancement in the broad fields of engineering for suitable candidates. Applicants should be aged 21–28 and have a first or second class honours degree. Salary in accordance with qualifications and experience. Applications in writing to Staff Department, Hexagon House, Blackley, Manchester, 9. Ref. : INST.

Ministry of Supply requires **Engineer, Physicist** or **Mathematician** at Research Branch, Tolworth, Surbiton, to work on design and development of wide range of survey, photographic and printing equipment. Qualifications : 1st or 2nd class honours degree or equivalent in an appropriate subject, with at least 3 years relevant post-graduate experience. Administrative experience desirable. Salary within range, Senior Scientific Officer (minimum age 26) £917 – £1,075. Women somewhat less. Appointment unestablished. F.S.S.U. benefits may be available. Application forms from M.L.N.S., Technical and Scientific Register (K), 26 King Street, London, S.W.1, quoting A.194/53A. Closing date January 29, 1954.

Physicist with 1st or 2nd class honours B.Sc. degree or its equivalent, interested in light and optics, required for work on colours of printing inks and the evaluation of print quality. Research experience advantageous but not essential. The successful candidate will be required to possess normal or near-normal colour vision. F.S.S.U. Initial salary up to £707 10s. 0d. Application forms from **Printing, Packaging and Allied Trades Research Association, Patra House, Randalls Road, Leatherhead, Surrey.**

(*Continued on page iv*)

The British Northrop Loom Co. Ltd. are considering the appointment of a **Senior Scientist** to lead their Research Department. This is a new post offering excellent prospects and scope in an established and rapidly developing industry. Candidates must be first-class physicists and mathematicians, with a bent towards engineering, and preferably with some engineering experience. Commensurate salary, and generous pension scheme. Reply to the Secretary at the Company's registered office, Blackburn, Lancs.

Physicist with a good honours or higher degree required by **Dunlop Research Centre** to carry out fundamental research on textiles. Previous textile experience desirable but not essential. Applications in writing quoting reference J.M.22 and giving details of age, qualifications and experience to Personnel Manager, **Dunlop Rubber Co. Ltd., Fort Dunlop, Birmingham 24.**

LECTURES ON ATOMIC ENERGY

The University of London, Department of Extra-Mural Studies and The Atomic Scientists' Association announce a course of six University Extension Lectures on "Atomic Energy," to be held in the Beveridge Hall, Senate House, Malet Street, W.C.1, on Wednesdays at 7.00 p.m. commencing January 20, 1954. The speakers will be Sir John D. Cockcroft, Professor O. R. Frisch, Professor F. E. Simon, Dr. J. F. Loutit, Dr. E. E. Pochin, Professor Kathleen Lonsdale and Sir George P. Thomson. Admission fee for the course of six lectures is 10s. Tickets of admission may be obtained from the Cashier, University of London, Senate House, Malet Street, W.C.1.